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**How this Investigation Fits Within the Concept and Lesson Map:**

This investigation directly addresses the state standards. It develops the concepts of linear motion and prepares the students for the concept of rotational motion and rollers in the next investigations.

**Overarching question(s) for this whole investigation:**

* In what ways can a spinning object be kept in motion and how can they be changed? How do pushes and pulls affect the motion of an object?

**How People Learn Key Finding #1: Preconceptions**

**Attending to “How People Learn”**

**Eliciting Students Ideas:**

* Gather around the demonstration track. Set a toy car on the 50 cm mark on the track. Ask the student how could make the toy car start to move. Record their ideas trying to be specific for example if one states “push it” ask them to tell you how they want to push it.

**Common Student Preconceptions:**

* Students generally regard the state of rest (balance) as fundamentally different from the state of motion. (Driver)
* Young children will state that an object will stop moving or fall over because it wants to. (Driver)
* For something to move it must have a constant force or push. (Driver)
* If a body is not moving there is no force acting on it. (Driver)

**How People Learn Key Finding #2: Facts/Concepts/Knowledge**

**WA State Content Standards “Science Domains” (EALR 4):**

* 2-3 PS1A Motion can be described as a change in position over a period of time.
* 2-3PS1B There is always a force involved when something starts moving or changes its speed or direction of motion.
* 2-3 PS1C A greater force can make an object move faster and farther.
* 2-3 PS1D The relative strength of two forces can be compared by observing the difference in how they move a common object.

**WA State Content Standards “Science Domains” (EALRs 1-3):**

* 2-3 INQA Scientific investigations are designed to gain knowledge about the natural world.
* 2-3 INQC Inferences are based on observations.
* 2-3 INQE Models are useful for understanding systems that are too big, too small, or too dangerous to study directly.
* 2-3 INQF Scientists develop explanations, using observations (evidence) and what they already know about the world. Explanations should be based on evidence from investigations.

**Key understandings for the teacher:**

* These investigations were added to meet the State standards. After these investigations student should understand that a force is always involved when something starts moving or changes its speed or direction. The forces, in these investigations, always involve pushes or pulls.
* Teachers can connect back to these concepts when teaching the next Investigations.

**How People Learn Key Finding #3: Metacognition**

**Metacognition: How did my thinking change? What caused the change? How did I come to believe this?**

* In Part 1, discuss with the students their experiences during the lesson. Begin encouraging students to use terms like pushes and pulls, faster, slowly, rolling, bouncing, falling off the end of the track.
* After doing Part 2 have students write down in their science notebooks what they observed and learned. Next have the students draw a line of learning and share in their groups. After drawing another line of learning have the students share whole group. Each time students compare to their initial ideas.

**Suggested Assessments for Student Understanding:**

* As students explore marbles and motion have them draw or write down what they will try (a plan). Next, have them predict what will happen when tried (their prediction). Observe what happens when tried and then write down what was found. Use these notebooks entries looking for accurate motion concept understanding and use of appropriate vocabulary as well as the use of evidence to support findings.

**Additional Information**

**Materials and Student Management:**

* Use tape to put two meter sticks together to make the marble track. Use clay or model clay to keep the track level and stable. For the cars tape two meter sticks parallel together to make the track.

**Timing Considerations:**

**Additional Resources:**